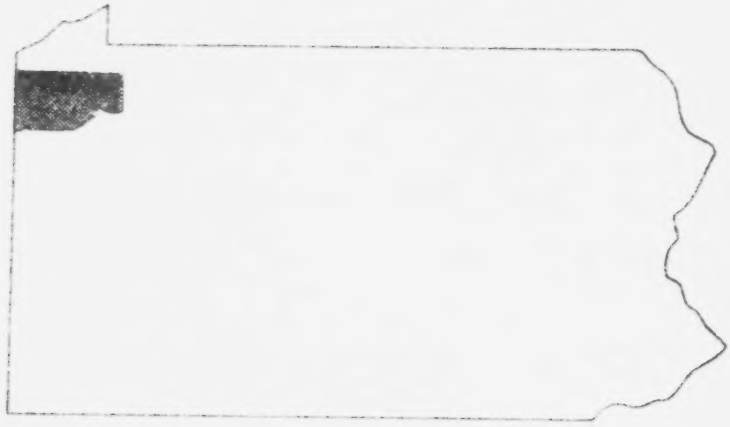
FLOOD INSURANCE STUDY

TOWNSHIP OF CAMBRIDGE, PENNSYLVANIA
CRAWFORD COUNTY



JUNE 1, 1982

Federal Emergency Management Agency

COMMUNITY NUMBER: 421664

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Flood Insurance Study Effective Date: September 19, 1984

Flood Insurance Study Revised: June 4, 1990

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FLOOD INSURANCE STUDY
TOWNSHIP OF CAMBRIDGE, CRAWFORD COUNTY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and updates a previous Flood Insurance Study/Flood Insurance Rate Map for the Township of Cambridge, Crawford County, Pennsylvania. This information will be used by the Township of Cambridge to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the Pittsburgh District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2. This work was completed in July 1988.

1.3 Coordination

On May 20, 1985, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA, the Crawford County Planning Commission, the township, and the COE (the study contractor) to determine the streams to be studied by detailed methods.

On July 6, 1989, a final CCO meeting was held with representatives of FEMA, the township, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Cambridge, Crawford County, Pennsylvania. The Borough of Cambridge Springs is not included in this study. The area of study is shown on the Vicinity Map (Figure 1).

French Creek was restudied by detailed methods for its entire length within the community, including its backwater effects on Conneauttee Creek and Little Conneauttee Creek. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through July 1993.

The remaining portions of Conneauttee Creek and Little Conneauttee Creek were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Cambridge.

2.2 Community Description

The Township of Cambridge is located in northern Crawford County in northwestern Pennsylvania. It is bordered by the Townships of LeBoeuf and Washington, Erie County to the north; the Township of Rockdale to the east; the Township of Woodcock and the Borough of Woodcock to the south; and the Township of Venango and the Borough of Venango to the west. The borough has a land area of 21.7 square miles, and lies approximately 12 miles north of the City of Meadville. The population of the borough was 1,389 in 1980, a 19-percent increase from the 1970 population of 1,654 (Reference 1).

French Creek has a total drainage area of approximately 1,235 square miles at its confluence with the Allegheny River, which it joins on the right bank at river mile 123.9, at the City of Franklin. It flows towards the southwest from its source near Chautauqua County, New York. The average stream gradient is approximately 4 feet per mile. The average hilltop elevation is 1,770 feet in the headwaters and 960 feet at its mouth. The average bed slope in the township is 2 feet per mile. Local relief above the stream varies from a low of 1,115 feet to a high of 1,340 feet at the upstream limit of study. The valley floor varies from 500 to 2,000 feet in width.

The climate for the Township of Cambridge and its surrounding area is temperate, with the normal seasonal variation in temperature. The area is geographically located in a region of variable air-mass activity, and is subject to polar and tropical, continental and maritime air-mass invasions. The weather is usually moderate, but frequent and rapid changes occur as a result of air-mass movement. Temperatures range from an average of 27 degrees Fahrenheit (^{o}F) in February to an average of 71^{o}F in July. Measurable precipitation occurs mostly on an average of 150 days per year, with an average annual precipitation of approximately 40 inches.

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CAMBRIDGE, PA

(CRAWFORD CO.)

APPROXIMATE SCALE

0 1/2 1 2 MILES

VICINITY MAP

2.3 Principal Flood Problems

Major floods may occur along French Creek at various times of the year. Floods occurring in the winter months are usually the result of heavy rainfall and snowmelt. Floods occurring during the summer months are usually the result of high intensity, short duration storms. French Creek is subject to considerable ice gorging, but those effects were not considered in this study.

The maximum flood of record along French Creek within the township of Cambridge occurred in January 1959. This flood reached an elevation of approximately 1,141.3 feet at the COE wire weight gage located at the Grant Street bridge over French Creek in the Borough of Cambridge Springs. Other known floods occurred in March 1913, April 1947, March 1960, March 1964, and September 1967.

2.4 Flood Protection Measures

There is one flood-control dam and reservoir upstream of the Township of Cambridge that is effective in reducing flood levels in the township. Union City Reservoir, completed in October 1970, is an earthen dam located on the main stem of French Creek, approximately 29 miles upstream of the township or at creek mile 71.5. It is a dry-bed reservoir with a capacity of approximately 47,600 acre-feet of storage and a drainage area of approximately 222 square miles. The present reservoir system reduces flood crests in the borough by approximately 1 to 3 feet. It controls approximately 43 percent of the drainage area upstream of the Borough of Venango.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied in detail affecting the community.

Natural discharge-frequency curves for French Creek were developed using stream gage records obtained at the U. S. Geological Survey (USGS) gaging station at Utica (No. 3024000) and the COE gage at Meadville. Continuous recording gage records at the USGS gaging station at Utica are available from August 1932 to the present. The COE has had numerous staff, chain, or wire weight gages on French Creek at the City of Meadville and in the basin for varying periods of time extending back to April 1908. Stream gage records have been available at the COE wire weight gage located at the Grant Street bridge in the Borough of Cambridge Springs since December 1965, but were not considered in this analysis. The historical flood records for the French Creek gaging stations were analyzed using the standard log-Pearson Type III analysis outlined in USGS Bulletin 17B (Reference 2). Flood-flow frequencies developed for French Creek were modified by means of an average reduction curve to reflect the reduction in drainage area by the upstream flood control reservoirs. The flows developed were verified by the National Weather Service (NWS) Dam-Break Flood Forecasting Model (Reference 3).

A summary of the drainage area-peak discharge relationships for the stream studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGE (cfs) 100-YEAR
FRENCH CREEK		
At downstream corporate limits	600	24,000
Upstream of confluence of Conneauttee Creek	515	19,300

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross-sectional data for French Creek were obtained from topographic maps, and as needed, were interpolated using the NWS Dam-Break Flood Forecasting Model (References 4 and 3). In addition, more defined channel cross sections were obtained from discharge measurements at COE stream gaging stations located along French Creek in the

Boroughs of Saegertown, Venango, and Cambridge Springs. Bridges and their effects on water-surface elevations were not considered directly by the NWS computer program, but bridge losses were generally included with the roughness factors shown below.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and the Flood Insurance Rate Map (Exhibit 2) where applicable.

Water-surface elevations of floods of the selected recurrence intervals for French Creek were computed using NWS Dam-Break Flood Forecasting Model (Reference 3). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations on French Creek were obtained from a continuation of the profile developed during preparation of the Flood Insurance Study for the Township of West Mead (Reference 5). The computed water-surface elevations were verified by comparing them to the well-defined floods of January 1959, March 1960, and September 1967 as well as to the rating curves developed from discharge measurements and high-water marks obtained at COE gaging stations. The results of the water-surface computations are tabulated for the selected cross sections for each stream segment (Table 2).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen based on channel characteristics and comparisons with completed studies in the French Creek basin. The channel "n" value for French Creek was 0.045, and the overbank "n" value was 0.070.

All frequency profiles were derived on the assumption that stable channels are maintained and that vegetative effects do not modify the roughness characteristics markedly. Although French Creek is subject to considerable ice gorging, no allowance was made for any effects from ice jams or debris.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

FLOODING SOURCE		RIVER CHANNEL				BASE FLOOD ELEVATION
CROSS SECTION	DISTANCE (MI.)	SECTION AREA (SQ. FT.)	DISCHARGE (C.F.S.)	MEAN VELOCITY (F.P.S.)	STREAM-BED ELEVATION FT. (NGVD)	FT. (NGVD)
A	42.37	6,486.5	24,000	3.7	1,[illegible]15.0	1,[illegible]50
B	43.60	8,000.0	24,000	3.0	1,118.0	1,136.33
C	44.40	6,315.8	24,000	3.8	1,118.0	1,137.83
D	45.89	6,315.8	24,000	3.8	1,118.0	1,[illegible]0.37
E	47.06	17,143.0	24,000	1.4	1,117.0	1,132.08
F	50.68	35,202.0	18,300	0.5	1,121.0	1,143.85

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CAMBRIDGE, PA
(Crawford County)

100-YEAR FLOOD DATA

FRENCH CREEK

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the streams studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 10 feet (Reference 4).

For the streams studied by approximate methods, the 100-year floodplain boundaries were delineated using the previously-printed Flood Insurance Study for the Township of Cambridge (Reference 6).

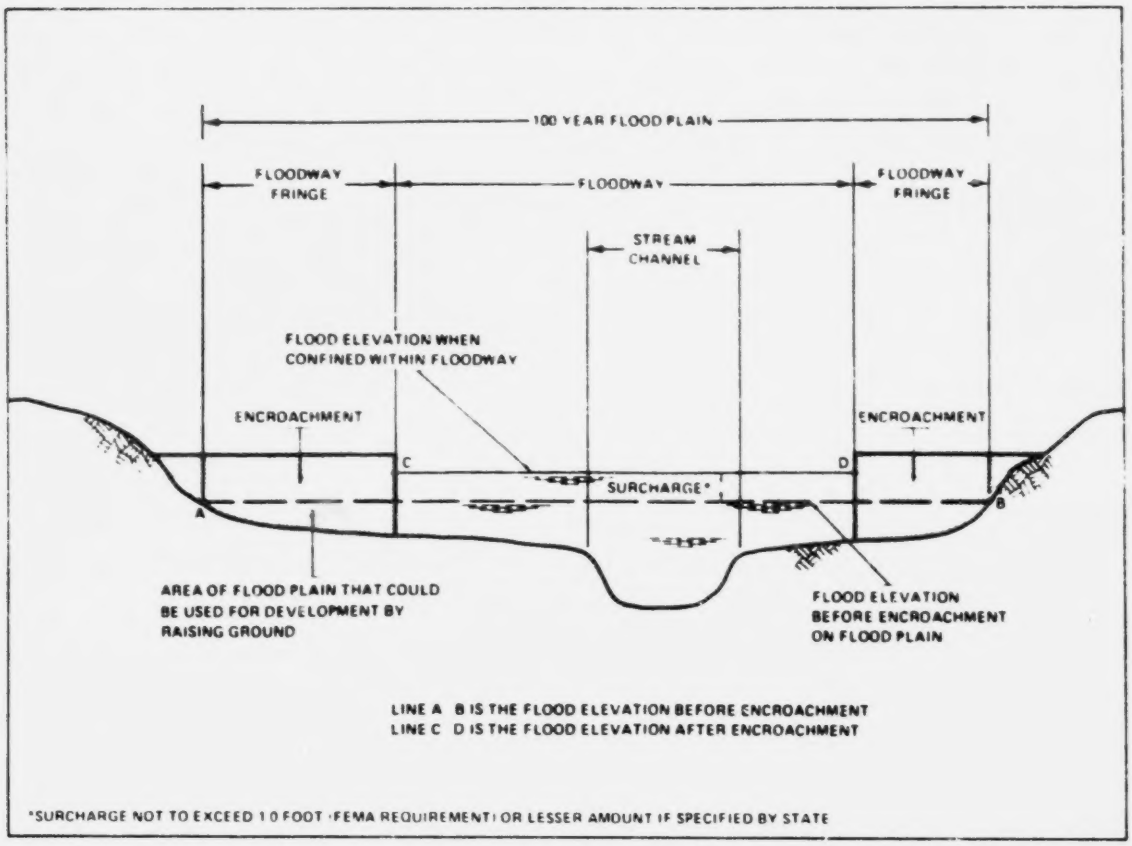
The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

No floodways were calculated as part of this study.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance

Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Townships of Washington and Venango, and for the Borough of Woodcock (References 7, 8 and 9). The results of this study are in complete agreement with the results of those studies.

Flood Insurance Studies are currently being prepared for the Boroughs of Cambridge Springs and Venango, and for the Township of Woodcock (References 10, 11 and 12). The results of those studies will be in complete agreement with the results of this study.

Due to its more up-to-date nature, this study supersedes the previously-printed Flood Insurance Study for the Township of Cambridge (Reference 6).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Pennsylvania, Venango, D. C., U. S. Government Printing Office, 1981.

2. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

3. National Oceanic and Atmospheric Administration, National Weather Service, Hydrologic Research Laboratory, in coordination with the U. S. Army Corps of Engineers, Hydrologic Engineering Center, DAMBRK - The NWS Dam-Break Flood Forecasting Model, February 1984.

4. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet: Cambridge Springs, Pennsylvania, 1968, Photorevised 1975.

5. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Township of West Mead, Crawford County, Pennsylvania, Washington, D. C., June 15, 1977.

6. Federal Emergency Management Agency, Flood Insurance Study, Township of Cambridge, Crawford County, Pennsylvania, Washington, D. C., September 10, 1984.

7. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Washington, Erie County, Pennsylvania, Washington, D. C., May 19, 1981.

8. Federal Emergency Management Agency, Flood Insurance Study, Township of Venango, Crawford County, Pennsylvania, Washington, D. C., February 1, 1985.

9. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Borough of Woodcock, Crawford County, Pennsylvania, Washington, D. C., January 17, 1985.

10. Federal Emergency Management Agency, Flood Insurance Study, Borough of Cambridge Springs, Crawford County, Pennsylvania (Unpublished).

11. Federal Emergency Management Agency, Flood Insurance Study, Borough of Venango, Crawford County, Pennsylvania (Unpublished).

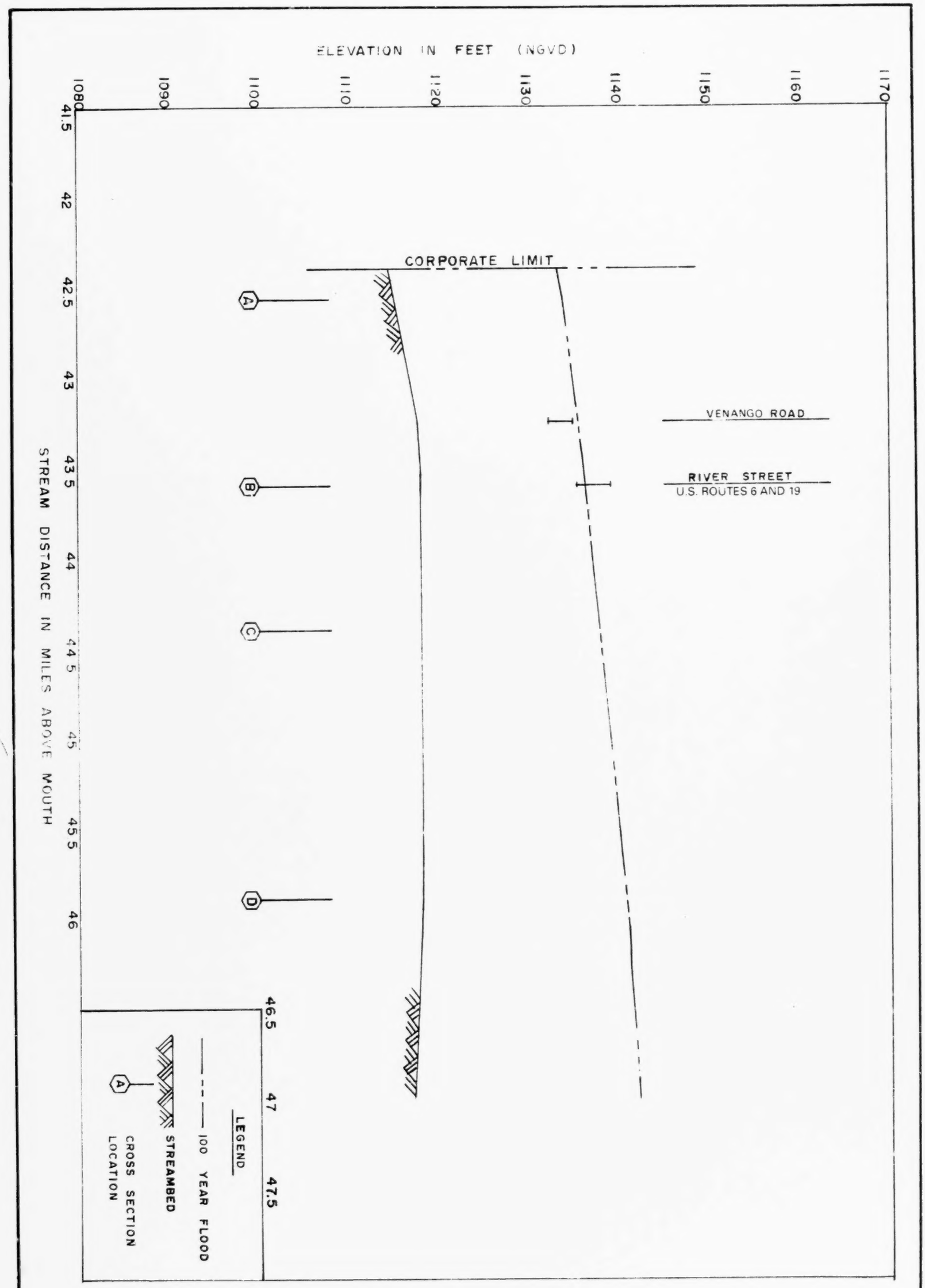
12. Federal Emergency Management Agency, Flood Insurance Study, Township of Woodcock, Crawford County, Pennsylvania (Unpublished).

EXHIBIT 3 - ELEVATION REFERENCE MARKS

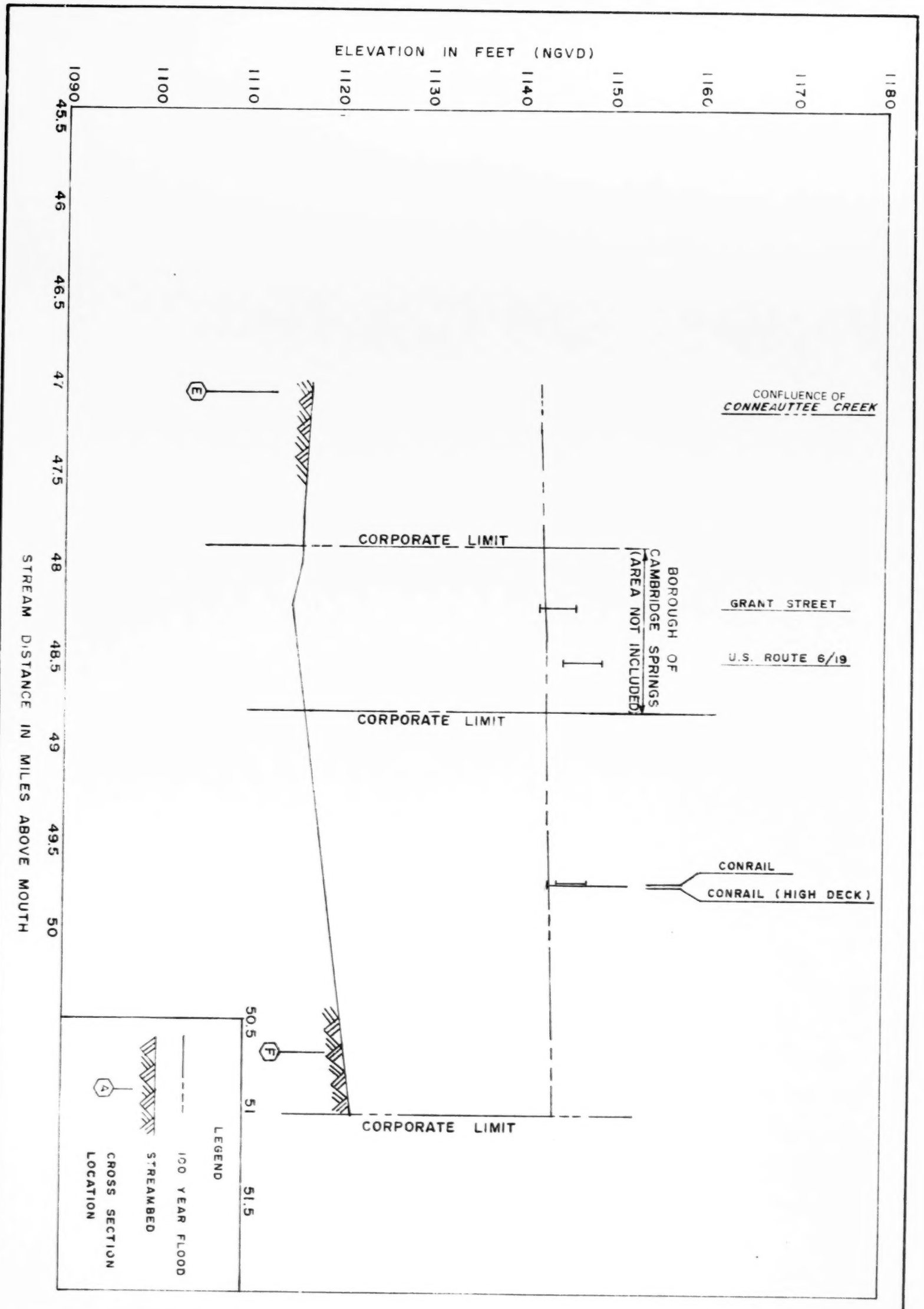
Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	01	1,151.72	USC&GS disk, stamped N 142 1941, in east corner of concrete base of southwest steel pillar of CONRAIL bridge No. 91.86, approximately 10 feet west of west rail of southbound track and approximately 3.6 feet higher than ground.
RM 2	01	1,135.02	L cut on the downstream right bank abutment of Venango Street bridge over French Creek.
RM 3	01	1,138.26	Penndot disk set on downstream right bank wing wall of US Routes 6 and 19 bridge over French Creek.
RM 4	01	1,154.33	USC&GS disk, stamped M 142 1941, set in east corner of north abutment of CONRAIL bridge No. 91.22, approximately 11.3 feet north of northeast corner of steel bridge wall and approximately 8.7 feet east of east rail of east bound track.
RM 5	01	1,168.95	USC&GS disk, stamped K 142 1941, approximately 1.2 miles southwest along railroad tracks from station in Borough of Cambridge Springs, approximately 24.9 feet west of small concrete telephone building, in north corner of east abutment of CONRAIL bridge No. 88.89, approximately 5.8 feet north of north rail of westbound track, and approximately 1.3 feet south of northeast iron guardrail post.
RM 6	02	1,137.14	Penndot disk set in downstream right bank wing wall of road bridge over mouth of Conneauttee Creek.
RM 7	04	1,159.18	USC&GS disk, stamped K 142 1941, set in north corner of east abutment of CONRAIL bridge over small tributary to French Creek.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 8	04	1,164.40	USC&GS disk, stamped H 142 1941, set in retaining wall between railroad track and CONRAIL station in Borough of Cambridge Springs, approximately 13 feet northwest of northwest corner of station building; set in steps approximately 3 feet east of west end of platform.
RM 9	05	1,145.59	L cut on downstream left bank wing wall of Grant Street bridge over French Creek.
RM 10	04	1,148.59	Chiseled A on downstream right bank abutment of US Routes 6 and 19 (Main Street) bridge over French Creek.
RM 11	04	1,146.53	USC&GS disk set in north corner of east abutment of CONRAIL bridge No. 87.14 over French Creek.



01P	FEDERAL EMERGENCY MANAGEMENT AGENCY TOWNSHIP OF CAMBRIDGE, PA (CRAWFORD COUNTY)	FLOOD PROFILES FRENCH CREEK



02P	FEDERAL EMERGENCY MANAGEMENT AGENCY TOWNSHIP OF CAMBRIDGE, PA (CRAWFORD COUNTY)	FLOOD PROFILES FRENCH CREEK